ART. VII.—*Statistics of Re-vaccination.* By SAMUEL FORRY, M. D., of New York.

ALTHOUGH *vaccination* and *variolous inoculation* are both discoveries which attest the wonderful efforts of the human mind in unfolding the secret provisions which a beneficent nature has provided for the mitigation of her most baneful pestilences; yet the history of vaccination unfortunately proves that the sanguine anticipations of its early advocates, viz., that nature has thus furnished us with a means adequate for the complete extermination of small-pox from the face of the earth—are vain and illusory. The brilliant prospect that dawned upon the early history of vaccination, was clouded, even before the death of its illustrious discoverer, by incontrovertible facts, tending to show that the susceptibility of the human frame to small-pox is not entirely destroyed during the whole subsequent term of life. Notwithstanding the vaccinated may possess an immunity *communibus annis,* experience soon demonstrated that this prophylactic virtue fails in years of epidemic prevalence. But although the results of time have shown the error of these premature assumptions, yet the benefits conferred upon the human family are sufficiently great to place the name of JENNER among its greatest benefactors—a judgment in which the physicians of all countries are at this day unanimous. That good and evil shall be blended, is a general law of our physical and moral nature, to which the history of small-pox and vaccination offers no exception. Now that the practice of vaccination is almost universally adopted, to enlarge upon its extraordinary protective influence were a waste of time. In a word, how unrequitable are the obligations of mankind to him who, eliciting this mysterious secret from the dark recesses of rural tradition, rendered it available to all human kind!

Of late years, small-pox has shown a tendency to re-assume its formidable ascendency among epidemic disorders; and as one attack of the disease does not always render the individual insusceptible of the variolous contagion, it is not to be expected that the vaccine virus will afford an infallible protection. In several epidemics of variola, it has been found that among those who had previously undergone the disease, a greater number were seized than among those who had been merely vaccinated; and it may be added, in reference to the protective powers of the cow-pox, that Roberts, in his account of the small-pox epidemic which occurred at Marseilles several years ago, states that 1473 unvaccinated fell victims to the natural disease, whilst only 45 vaccinated died of the varioloid.

A point which has, within recent years, been much agitated, is, the duration of the protective influence of vaccination. The question has naturally occurred, whether this influence diminishes in any general ratio to the period of time succeeding vaccination. To determine this point, we must look to statistical facts. That such a relation does exist, though not with any exact uniformity of rate, appears from the results of re-vaccination, and from other data connected with this subject. These facts concur in showing that the ratio of cases of small-pox after vaccination is low before ten years of age—that from the age of 15 to 25 it is at its maximum—and that from this period it diminishes. It appears further that the following laws have been pretty clearly determined: 1. When the interval between the primary and secondary vaccination does not exceed five years, the skin seems entirely insensible to the vaccine poison. 2. After an interval exceeding ten years, the virus most commonly irritates locally, a scab forming on the eighth day, which, soon falling off, leaves no permanent cicatrix; and 3. In another class of cases, after the same interval, the second vaccination runs a perfectly regular course, the lymph being found to propagate a good and genuine cow-pox. Now, as it seems to be generally admitted that the susceptibility to be affected by vaccina indicates a similar liability to variola, and *vice versa*, it is presumable, when re-vaccination is followed by a genuine vesicle, that the individual is equally subject to the influence of the miasm of small-pox. If then the two viruses are equally destructive of each other, it follows that the first class of cases above described will effectually resist the infection of small-pox; that in the second the disease would be much modified; and that in the third, under circumstances favourable to the development of variola, the malady might exhibit all the virulence of its unmodified form.*

As regards the data constituting the basis of this paper, it may be remarked that they were furnished at Fort Wood, in the harbour of New York, which offers, from the circumstance of its being a depot for recruits, great facilities for prosecuting inquiries in relation to vaccination. On an average of the last five years, 1800 recruits have annually passed through this post, all of whom it is necessary to re-examine, with a view to physical and mental defects, and every one of whom ought, without reference to previous vaccination, variolous inoculation, or natural small-pox, to be vaccinated. Acting upon this opinion, the writer, whilst stationed at this post, (from May to November, 1840,) subjected every recruit, except the few vaccinated at several of the recruiting stations, to the influence of vaccine virus. Previously, it was customary to vaccinate those only who did not exhibit marks of variola or distinct cicatrices of prior vaccina. In the cases comprising the statistics now presented, two punctures were generally made in each arm with fresh virus (crusts) obtained from the Surgeon General's office, or matter (either crusts or lymph taken on the eighth day) procured from subjects just vaccinated. The register was kept with as much accuracy as practicable. Some difficulty was necessarily experienced from the ignorance of individuals, some having no knowledge of any difference between small-pox and cow-pox. The results now presented are intended, without deducing any general conclusions, merely as a contribution towards the mass of statistical facts already furnished by different countries of Europe.

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* Dr. Jenner himself, in his *original* essay, announced that in the human body the susceptibility to cow-pox is, after a time renewed. *Cyc. of Pract. Med.*, art. *Vaccination.*

Of the 686 recruits vaccinated at Fort Wood, 285 were natives of the United States, 242 of Ireland, 81 of Germany, 49 of England, and the remaining 29 of other countries. This fact is of no further importance than as showing the general character of the persons subjected to the operation. The majority belonged to the humbler walks in life; some there were who, by dissipation or extravagance, had reduced themselves from a higher sphere in life to the necessity of enlisting; whilst the Americans who fill the ranks are, with scarce an exception, such as have proved themselves unfit for the trusts of civil life. The mean age of all, (excluding 40 boys with an average age of 15,) was 25 years.

Of the total (686) vaccinated, 560 had been previously vaccinated, 74 had had small-pox naturally; and 52 had not been innoculated either with the vaccine or variolous virus, or had not had the disease naturally. It is thus seen, that these statistics are not entirely restricted to cases of re-vaccination.

Among the series of questions put to each recruit was this one,—Have you ever been exposed to the contagion of small-pox? And to this interrogatory, among the 560 previously vaccinated, 371 answered in the affirmative and 189 in the negative. Of the former, 39 had, according to their own views, which were corroborated by the pitted condition of the face, suffered from small-pox in a modified form; but some of these, perhaps nine, averred, upon traditional authority, that they had taken the disease at or about the period of vaccination in infancy. Although we admit, that vaccination is by no means an invariable prophylactic against an attack of small-pox, yet it must be borne in mind, that it is impracticable to determine whether the systems of persons having variola or varioloid subsequently to vaccination, had been fairly and fully subjected to the influence of the cow-pox virus. In some of these cases, too, especially those which occurred at the period of vaccination in infancy, the cicatrices may have been of varicellous origin—an opinion favoured by the fact, as will be shown more fully, that a large proportion of these alleged cases of natural small-pox, exhibited, when re-vaccinated, genuine vesicles; but as cases of *recurrent* small-pox do occur, it is no ways improbable that in constitutions having a peculiar susceptibility to small-pox, designated the *variolous diathesis*, genuine vaccina may follow genuine variola. Various attempts have been made to determine the proportion of the vaccinated who take small-pox, but these calculations are grounded on such imperfect data, that we cannot attain even an approximation to the truth.

Of the 560 previously vaccinated, 381 exhibited good cicatrices; in 134, they were indistinct or imperfectly developed; and in 45, no cicatrix was visible, the operation in these last having, according to their own assertion, succeeded imperfectly, or, after two or three trials, failed.

Of the total vaccinated, (686,) perfect, regular, and well-formed vesicles followed in 188; and in 63 besides, the characteristic marks, with some anomalies, were exhibited. In these last, in some the specific inflammation proved very violent, the vesicle, instead of drying into a hard scab, being converted into an ulcer; and in others, which was the larger proportion, the vesicle became prematurely red and itching, forming a conoidal pustule, which contained, instead of a clear and transparent lymph, an opaque fluid surrounded by a slight areola of irregular shape; and the succeeding scab, which was small, dropped off prematurely. In these latter cases, it is presumable, that the individuals possessed a partial immunity from small-pox.

But it is necessary, in these statistics, to distinguish the previously vaccinated, the unvaccinated, and those who had laboured under variola. Of the 560 previously vaccinated, 196 took the disease on revaccination, including those cases (55) which, from the irregular progress of the vesicle, have been regarded as affording a partial protection from cow-pox. Of these 196, 109 had been previously vaccinated before the age of 5 years, 48 between the ages of 5 and 10, and 39 subsequently to the latter age. To determine then the period during which vaccination gives a "charmed" life, it is necessary to institute a comparison between these results and the whole number vaccinated. Thus, of the 560 previously vaccinated, 316 took place before the age of 5 years, 133 between the ages of 5 and 10 years, and 111 after the latter period. Hence it follows, as the ratio of successful revaccination is almost the same after each interval, that the limit of the protective power of cow-pox is not restricted to any precise number of years; but that the development of the adult constitution, as corroborated by the experiments of Dr. Heim, and perhaps the influence of change of climate, may be regarded as closely connected with the subsequent susceptibility of cow-pox and small-pox. It has been already observed, that the ratio of cases of small-pox after vaccination, increases at the period of puberty, and especially between the ages of 18 and 25. The opinion that cow-pox wears out in the course of years, has now become a familiar notion—a doctrine that was most resolutely opposed by Jenner after changing his early views; but even now, there are some who would confine the decadence of vaccine influence to cases of doubtful vaccination. It is, therefore, still a mooted question, whether the doctrine of a limitation in the period of vaccine security is fairly applicable to those cases in which the vaccine pock is regular in every respect, and when the constitution, at the same time, gives evidence of internal derangement, and the resulting cicatrix is well-defined and permanent in after-life.

Of the 74 individuals, who had previously suffered from small-pox in the natural way, 29 now exhibited the genuine vaccine vesicle. Of these 29, 12 had distinct marks of small-pox on the face, trunk, and extremities, 9 were slightly pitted, and 8 presented scarcely any perceptible scars. The question whether the pits or cicatrices in any of these cases, were caused by a varicellous eruption, can, of course be now only a matter of opinion; but assuming that they were of a genuine variolous character, we must infer that the preservative or counteracting power of small-pox does not exceed that of cow-pox—an opinion which has been recently corroborated by like statistical results in France. Moreover, in a late debate before the *Medical Society of London*, Mr. Dendy "alluded to three cases, which had come under his notice, of secondary small-pox occurring in children, who were deeply pitted by the first attack of the disease; while other children, in the same families, who had been protected by vaccination, merely suffered from a varicelloid eruption, which was followed by no secondary fever." But as a general rule, it cannot be doubted that vaccinated persons are more liable to attacks of small-pox than those who have once undergone that disease. Most of the individuals referred to in these statistics, had the small-pox before the age of ten years. Among his notes, the writer finds the following remarks:—"A German, ætatis 26, who is much pitted and scarred, and who shows a well-marked cicatrix of a successful vaccination, at a period of his life prior to the varioloid attack, now exhibits genuine vaccina. A Pole, ætat. 29, has a good cicatrix, having been vaccinated when six years old, and although often exposed to the contagion of small-pox with impunity, has now true vaccine pustules. Two other individuals, one ætat. 27, and the other 32, both vaccinated before two years of age, and both often exposed to variolous infection with impunity, have now genuine kine-pock. An Irishman, ætat. 24, says that he underwent inoculation with the virus of small-pox when four years old, and shows 4 or 5 imperfectly marked pits on the face, which appeared, he avers, at the same time; although often exposed to variola with impunity, he now presents the true vaccine disease. An American, ætat. 33, has no cicatrix of vaccination; he avers that the operation, which was performed several times, invariably failed, and that he has been on board ship with 200 cases of small-pox without contracting the disease; and in the present instance, there is again a failure." Whilst the last is a case of natural insusceptibility of small pox, being one of those rare diatheses which enable persons to pass through life apparently insensible to the variolous and vaccine poisons, the preceding cases show a condition of the system termed the *variolous diathesis*, which favours the phenomenon of recurrent small-pox.

Of the 52 unvaccinated, the operation succeeded perfectly in 25. Some of these were registered as unvaccinated merely because no cicatrix was visible; but the absence of this cannot be taken as absolute proof that the individual had never been vaccinated.

It has generally been regarded that a distinct, circular, radiated, punctulated, and not very large cicatrix, affords a pretty certain indication that the vaccine affection is perfect; but the data here presented do not show that the system which has this cicatrix, is more secure, after a lapse of 15 or 20 years, against secondary vaccine disease, than those constitutions in which the cicatrix wants these distinctive characters. This conclusion is deduced from the fact that the two kinds of vesicles here reported as succeeding re-vaccination, viz., the *perfect* and the *anomalous*, (the former being supposed to indicate the *complete*, and the latter the *partial* protective influence,) followed in about an equal ratio in the cases of *distinct*, *indistinct*, and *invisible* (those alleged to have disappeared) cicatrices. In each of these three classes of scars, the perfect vesicles averaged about one in every four re-vaccinated; and the anomalous vesicles maintained the mean of about one in every ten. It has been already established in Europe by statistical facts, that the character of the cicatrix does not enable us to determine how far the variolous disease supervening, will be modified; and this opinion, reasoning upon the doctrine that cow-pock and small-pox are identical in their nature, is corroborated by the data just adduced.

In regard to the identity of the vaccine and variolous virus, it may be here observed, that the opinion has received a very remarkable corroboration in the recent experiments of Mr. Ceely, of England, which seem to prove that not only may the cow be inoculated with variolous matter, but it may be thus converted into vaccine. Two experiments made by Dr. Thiele, of Kasan, in Russia, appear to confirm the same result. In 1836, he inoculated some cows on the udder with the matter of small-pox, which produced vesicles bearing all the characters of the true vaccine vesicle in those animals. During seventy-five successive transmissions in the human subject of the vaccine virus thus procured, it appeared always to retain its normal character. In 1838, M. Thiele repeated this experiment with the same success. As the local symptoms were more intense, and the consecutive fever more severe than usual, during the first transmissions through the human frame, he advises at first the dilution of the lymph with milk. But even admitting this common origin, the inference that the diseases are identical, acknowledging the same laws, does not necessarily follow. Experience, however, seems to show that the predisposition to the two diseases is the same. Even the constitutional inaptitude to cow-pox denotes a like inaptitude to small-pox.

From a general view of all these facts, it may be concluded, as an approximation to the truth as near as such imperfect data will allow, that among the 560 cases of re-vaccination, 364 retained complete protection, and 55 partial immunity, while the remaining 141 had entirely lost the protective influence.

To remedy the acknowledged defects of vaccine influence, two practical measures have of late years been suggested, viz., re-vaccination at distant intervals from the period of the primary process, and recurrence to the cow for primary lymph. To show the effects resulting from the operation of re-vaccination, has been the main object of this paper. The Germans are very decidedly in favour of the measure, whilst the French, it would seem, are divided on this question. That it need never be recommended prior to the tenth year, appears to be generally conceded; and equally unanimous is the opinion that the most suitable age is from the period of puberty to that of confirmed manhood.

It appears, by an official announcement of the Prussian government, that in 1834, 44,454 soldiers were re-vaccinated. Of these, 33,634 exhibited distinctly marked cicatrices of the previous vaccination; 7134 presented indistinct or imperfect cicatrices; and in 3686, no scars were visible. In 16,679 of the re-vaccinated cases the progress of the vesicles was regular and complete; in 12,287, irregular; and in 15,488 the vesicles, or rather the papulæ, were quite abortive. The operation having been repeated a second time in 4530 cases, it took effect only in 866. During the same year there were 38 fatal cases of variola. Of these, two occurred in individuals who had been re-vaccinated with effect; six in persons in whom it had failed; and the remaining 30 cases in young recruits who had not been re-vaccinated. From these data, the Director of the Medical Department concludes that he is warranted to urge on the military surgeons of the Prussian army the propriety of re-vaccinating, even a second or a third time, every soldier in whom the operation has not yet been repeated.

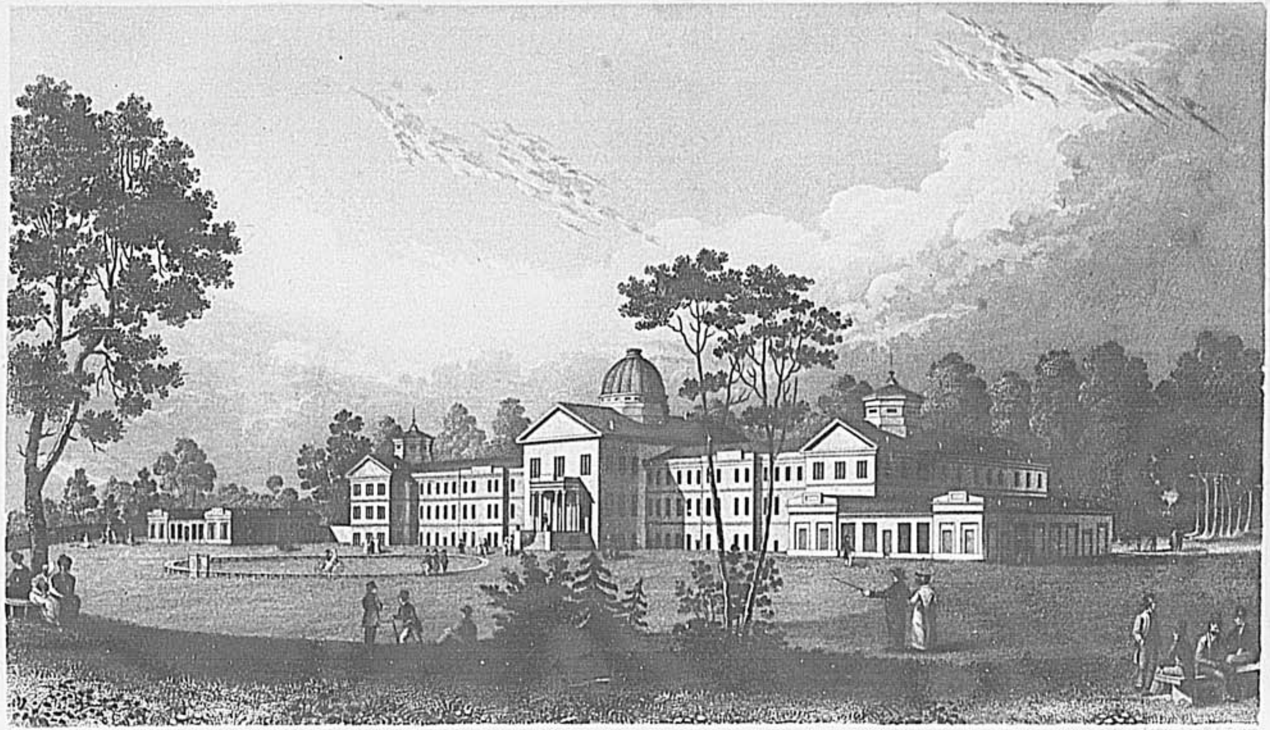
A commission consisting of the most distinguished physicians and surgeons of the French metropolis, appointed in 1838 by the Institute of France, to examine various papers connected with this subject, recommended the practice of re-vaccination after the lapse of about 15 years, and that, as the vaccine virus degenerates by being transmitted through many human systems successively, recurrence should be had occasionally to its primitive source in the cow.

More recently there has appeared a table prepared by M. Villeneuve, the reporter of a commission appointed by the Royal Academy of Medicine, exhibiting the general results of the vaccinations and re-vaccinations performed, &c., compiled from reports sent from forty-one departments; from which it appears that of 2199 cases, in which re-vaccination was performed on persons of different ages and sexes, who had been successfully vaccinated at some previous period of their lives, the operation took effect in 223 cases only, which would give the proportion of nearly one to ten. Now this ratio is far below that of the Prussian army given above, which, if limited even to "regular and complete" vesicles, is three times greater. The writer's statistics, it has been seen, afford an average much nearer to that of Prussia.

Again, according to the Annual Report of the Vaccination Committee of France, in 1839, of 6652 re-vaccinations, which were carefully watched, a pustule similar to the normal one, was observed in 718 cases; in 1283 cases, the pustule was of a doubtful character, and in 4651, the operation failed completely. The following are the general conclusions of the committee:— 1. It thus appears that a large majority of persons are not capable of contracting vaccinia twice, and consequently, that revaccination is generally useless. 2. Even when revaccination has had a positive result, it has not always protected the person from the contagion of variola. 3. Revaccination, at least as a general measure, is disapproved of by most medical men, on the ground that the confidence of the public would be shaken, by thus exhibiting a want of faith on the part of the medical profession. 4. It is maintained that the vaccine virus has undergone no change by having been transmitted through a multitude of persons. 5. The immense majority of the vaccinated, though in immediate contact with those that were suffering, remained unaffected, either by the sporadic or the epidemic variola. 6. Vaccination has unquestionably continued, in the epidemics of small-pox which have occurred in different departments, to possess the power of arresting the evil, by reducing the genuine variola to varioloid disease. This report was strongly opposed by some members of the Academy, on the ground that it was too decided and preremptory. It was remarked by M. Bousquet, that, from his own experience, he could say, that a perfect normal pustule was induced in 30 among 138 cases of re-vaccination. Of 90 persons at Versailles vaccinated by him, in 37 genuine vaccine pustules followed. M. Piorry suggested, that re-vaccination might possibly protect from the varioloid, as the first vaccination does from variola itself.

It is thus seen that the results of re-vaccination are very different in different countries, as for example in France and Germany. These statistical reports afford no safe or conclusive data upon which to build general deductions, for the reason that it cannot be known with certainty, whether the first vaccination was successful.

The growing impression, that vaccine virus deteriorates in power in proportion to the number of times that it makes the circuit of the human body, has of late years led physicians to revert more frequently to the cow for supplies of lymph. Against the general adoption of this proposal, several strong objections exist. When first taken from the cow, the true vaccine lymph is often very acrid, producing local inflammation and glandular swellings; as regards the genuineness of the new stock, there will always be doubt until the undesirable experiment of variolous inoculation has been made; and lastly, years will often elapse before the true cow-pox, even in large dairies, can be found. The experiment was tried in Italy upon a large scale in 1829, when the alarm of epidemic small-pox induced the Piedmontese physicians to make trial of a variety of new stocks of lymph; but the result was, according to Dr. Griva, chief of the Vaccine Establishment at Turin, "that no perceptible difference was to be traced between the aspect and progress of the old and the new, the primitive and the long humanized virus." More recently, the plan of recurrence to the cow has been largely experimented upon in Germany, France, England, and Russia, and occasionally it has been thought, that the new lymph possesses superior efficacy; but, upon the whole, the results have not been of a character to warrant its general adoption. In England, within a year or two, recourse has been had to the variolo-vaccine.



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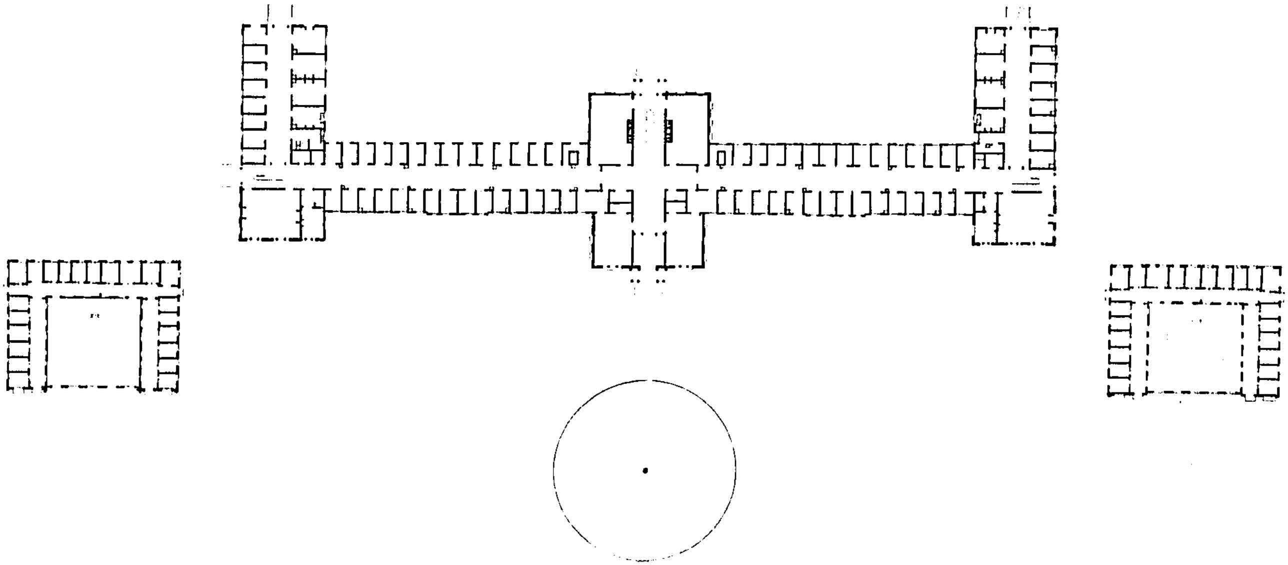

PLAN OF THE PRINCIPAL STORY

F. L. FOR THE INSANE